DOCUMENT RESUME

ED 417 950 SE 061 247

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TITLE Secondary Preservice Science Teachers Ideas About Culture, Ethnicity, and Learning of Marginalized Students.

PUB DATE 1995-04-00

NOTE 36p.; A version of a paper presented at the Annual Meeting of the National Association for Research in Science Teaching (San Francisco, CA, April, 1995).

PUB TYPE Reports - Research (143) -- Speeches/Meeting Papers (150)

EDRS PRICE MF01/PC02 Plus Postage.

DESCRIPTORS Case Studies; Constructivism (Learning); *Cultural Influences; *Ethnicity; Higher Education; *Preservice Teacher Education; *Science Education; Secondary Education; *Student Attitudes; Teacher Education

ABSTRACT

This collective case study focuses on three preservice teachers' ideas about culture and ethnicity and the influence of the two on students' science learning. The preservice teachers (N=3) had general ideas about culture but the concept of ethnicity was perplexing to them. Often the terms "culture" and "ethnicity" are equated by the students indicating that the distinction is unclear. Two of the participants in the study did not believe that the culture and ethnicity of students influences their science learning and instead suggest that these elements dictate students' interactional patterns, styles of dress or overall appearance, and personality. Contains 39 references. (Author)

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Running Head: CULTURE, ETHNICITY, AND LEARNING

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Secondary Preservice Science Teachers Ideas About Culture, Ethnicity, and Learning of Marginalized Students

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A version of this paper was presented at the annual meeting of National Association for Research in Science Teaching, April, 1995, San Francisco, CA.

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Abstract

This collective case study focuses on three preservice teachers' ideas about culture and ethnicity and the influence of the two on students' science learning. They had general ideas about culture; however, the construct of ethnicity was more perplexing to them. Oftentimes the terms culture and ethnicity were equated, therefore, reflecting that they could make few distinctions between the two constructs. Two of the participants in the study did not believe that culture and ethnicity of students influenced their science learning. They believed that culture and ethnicity were elements that dictate students' interactional patterns, styles of dress or overall appearance, and personality.

Secondary Preservice Science Teachers Ideas About Culture, Ethnicity, and Learning of Marginalized Students

Introduction

The mirrored components of a kaleidoscope produce very unique, yet beautiful images with each rotation. Similarly, the cultures and ethnicities of students in the classroom represent the components of a kaleidoscope and render a view of the uniqueness and variation in students' experiences, ideas, and beliefs. Teachers who share this kaleidoscopic view have opportunities with each turn of the academic year to experience a mosaic classroom and draw upon the richness of culture and ethnicity for their teaching of science. As a result of an ever changing and highly diversified student population in the United States, the field of science education has begun to examine the importance of the mosaic classroom. Hence, there has been an increasing amount of research geared toward the inclusion of multiculturalism as a fundamental theme in the learning and teaching of science. However, traditional preservice programs in the United States have not emphasized or required the incorporation of multicultural education in their curriculum (Boyer & Radzik-Marsh, 1994). As a result of these exclusions, many of these teachers are not adequately prepared to face the reality of their classrooms (McDaniel, Devi, Crockett, & Atwater, 1995). Such characteristics as culture and ethnicity are thought to contribute to students' self-concept and academic success, as well as the negative behaviors and expectations of teachers (Atwater, 1994). In addition, prior research findings have indicated that teachers' experiences do influence their perceptions about their students' ethnicities, gender, or social class. Self-actualization of a teacher in terms of cultural and ethnic identity

provides a framework for understanding, respecting, and valuing their students as individuals and their students' learning (McDaniel, Devi, Crockett, & Atwater, 1995).

The purpose of this qualitative study was to investigate whether secondary preservice science teachers' ideas about culture and ethnicity influence their beliefs about science learning and their interactions with students from cultures and ethnicities different from their own. Thus, this research provided an opportunity to answer such critical questions as:

(1) What are preservice teachers ideas about culture and ethnicity?

(2) Do preservice teachers think culture and ethnicity influence the science learning of marginalized students?

Teacher educators have the opportunity to address preservice teachers as to the realities of classroom diversity and to create a new social environment to prepare students for the challenges that await. In focusing on theese research questions, the aim is to provide answers, suggestions, and alternatives to some of the problems and difficulties preservice science teachers may face when confronted with instructing marginalized students. For the purpose of this paper (recognizing that other groups could be included in this category), marginalized students will refer to Asian, Black, Hispanic/Latino, and Native American students. The results of this study will have implications for the establishment of preservice science teacher education programs that focuses on the development of multicultural science teachers.

Review of the Literature

Limited research has been conducted on teacher development. Nevertheless, most of the available studies on teacher development proposed that teachers progress through various developmental stages before becoming successful in their classroom instruction

(Wiggins, 1993). Fuller (1969) believed that beginning teachers advanced through various phases of concerns about becoming a teacher. The phases included self-, task, and student impact concerns. Marso and Pigge (1989) hypothesized that these concerns were sequential and accumulative as one progressed through the teaching experience. According to Fuller (1969), self-concerns of prospective teachers engaged in early preservice teacher education center around their own survival as students. The teachers generally displayed a lack of concern about teaching, as well as possessing little understanding of their students. As more preservice teaching experiences were gained, concerns about teaching began to emerge (task concerns), but survival was still an important factor to prospective teachers. Finally, as preservice teachers matured as a result of their teaching experiences, they became increasingly concerned with students' learning and growth (Marso & Pigge, 1989).

Prior research findings have indicated that teaching is influenced by both science content and the student (Hewson, Karby & Cook, 1995). Burden (1980) suggested that one can develop into a successful classroom teacher through acquisition of content and pedagogical knowledge. Although acquisition of content and pedagogical knowledge are legitimate concerns in teacher development, significance of acquiring, understanding and valuing one's own culture and ethnicity are important aspects in the development of preservice teachers. Teachers' acknowledgment of the uniqueness of their own cultures and ethnicities facilitates an understanding and appreciation of the two and could initiate change in teachers to focus on the learning needs of marginalized students.

Culture

Culture is a complex and dynamic issue to address in any setting. Therefore, its influence has been found to be an important determinant of students' learning and academic success (Hale-Benson, 1984), as well the learning and success of science teachers. Trying to adhere to one strict definition of culture often does not describe the differences that exist between the groups. In general, culture refers to the norms of a particular group of people that influences their world views and behavior (Bullivant, 1989; Davidman, 1995). Timm (1996) believed that culture included the beliefs, knowledge, values, and attitudes of a group that subsequently influence and shape the way in which they view the world around them. It offers teachers and teacher educators a way of understanding variations in their actions toward students. According to Nieto (1994), the implicit aspects of culture such as communication style, attitudes, beliefs, social interactions, and values are the most difficult to identify. Thus, teacher's understanding of culture may serve as a foundation for selecting appropriate instructional strategies, behaviors, and interactions toward marginalized students.

Ethnicity Identity Development

The terms race and ethnicity are often used synonymously, but the assumption that the two are equivalent is an erroneous one. Race could be an aspect of ethnicity, but ethnicity is not limited to race. Race is primarily a psychological construct that serves people's apparent need or desire to make distinctions between themselves (Shreeve, 1994). Ethnicity is more inclusive of an individual's shared group membership with others of similar ancestral heritage. Ancestral heritage consists of such domains as the psychological,

cultural, and social, rather than skin color and other physical features alone (Barth, 1969). Martin and Atwater (1992) described ethnicity as the perception of "the uniqueness of an ethnic group by a person" (p. 4). Thus, the identity of a person is influenced by his or her ethnic membership.

Much research has been conducted on ethnic identity development; however, James Banks was the first to investigate ethnic identity development in teachers (Ford, 1979). Ethnic identity is a psychological construct composed of many facets, such as self-identification and knowledge of one's ethnic background. This allows one to establish ideas about ethnic self and ethnic group membership, formation, maintenance, and social ties (Knight, Bernal, Cota, Garza, & Ocampo, 1993). His typology was originally designed to describe some of the differences that existed between individual members of ethnic groups. This typology consisted of six stages of ethnic identity development: Ethnic Psychological Captivity (Stage I), Ethnic Encapsulation (Stage II), Ethnic Identity Clarification (Stage III), Biethnicity (Stage IV), Multiethnicity (Stage V) and Globalism and Global Competency (Stage VI). An expanded interpretation of the Banks' model offers a means of explaining the stages that individuals must pass through in order to become effective, culturally sensitive educators.

For people to develop ethnically, an event or an experience must occur so that a person's current feelings about ethnic self and other ethnic groups are confronted. Gay (1985) called these experiences encounters. Archer (1986) labeled these occurrences cultural bumps; instantaneous incidents in which a teacher from one cultural group finds herself or himself in different, strange, or uncomfortable situations when interacting with

other students and/or teachers of a different culture (Archer, 1986; Baptiste & Archer, 1994). Immediately following the cultural bump is a mirroring process (a verifying process in which the teacher meets with other group members to validate the "bump" or to legitimate the teacher's expectation of the "proper" student response). The destruction of the people's ideas about their own ethnicity begins their journey of reconstructing ethnic self.

Usually, effective science teachers instruct students from marginalized groups, along with mainstream groups, to learn science in the social context of the classroom. However, construction of knowledge extends beyond the classroom. The teacher's ways of teaching science do not always correlate with student's ways of learning science. If incompatibility exists, then this may interfere with the student's ability to understand new concepts. Science teachers must focus on the intersubjectively shared between themselves and their students and the social construction of meaning and knowledge. Social constructivism reflects the notion that the world that people create in the process of social exchange is a reality (Denzin & Lincoln, 1994). Gergen (1995) stated "terms by which the world is understood are social artifacts, products of historically situated interchanges among people" (p. 267). Since social constructivism focuses on making meaning, then researchers can use this epistemology, along with the multiculturalism paradigm to understand preservice teachers' ideas about culture, ethnicity, and learning.

Methodology

This study was a collective case study. Purposeful sampling was used in selecting participants for this study to obtain insights about the topics of culture, ethnicity, and learning. The primary criteria used to select the three participants in this study were (1) the

students' total score on the Teacher Student Instrument; (Ford, 1979), a Likert scale based on Banks' (1987) typology of ethnicity; (2) one of the students' methods and curriculum courses instructor's (participants) prior knowledge and observation of them; and (3) the student's willingness to participate in a year-long study consisting of interviews.

Sample

Three participants with the pseudonyms Ray, Sonia, and Tammy were ultimately chosen for this study from a science education class of 23. Ray is a White American male in his early twenties from a military family. He has lived in a variety of places in the United States; however, he has lived in a small southern city for most of his childhood. Sonia is a Hispanic female in her mid-forties. She grew up in a South American country and has lived in both Central America and the United States. During her graduate studies, she has interacted with people from various ethnicities, cultures, and social classes. Tammy is White American female in her early twenties from a small southern town located outside a major city. She has had limited experience with cultures and ethnicities different from her own. Yet, she is open and optimistic to learn and accept others.

Ray, Sonia, and Tammy's scores on the TSI were 3.45, 3.88, and 4.07, respectively. These scores serve as indicators of preservice teachers' stage of ethnicity. A score of 3 indicates that the teacher has accepted ethnic self and other group members; while a score of four indicates that teachers are able to participate positively and effectively within their own ethnic group as well as another ethnic group (Banks, 1987). With a score of five, teachers are at the multicultural level in which they possess the knowledge, skills, attitudes,

and commitment to function within a range of ethnic and cultural groups in their country (Martin & Atwater, 1992).

Procedure

Data collection for participant interviews was achieved through utilization of the standardized open-ended interview format and interview guided approach. Table 1 provides examples of questions used in the interviews. Each of the participants was interviewed by a different person. The interviewers were a White female, an Asian Indian, and an African American, all of whom were graduate students in a science education program.

Three interviews were conducted at different times with each of the participants, beginning in fall quarter. In an attempt to obtain truthful participant responses, the sequence of the questions relating to such salient topics as culture, ethnicity, and learning varied among the three participants. The sequence of the questions in the first interview remained the same for all three participants. However, these first interviews were the initial prompters that revealed a need for the interviewers to modify the original interviewing strategy, which was the standardized open-ended approach.

Insert Table 1 about here

All interviews were audiotaped and transcribed. Line by line analysis of the transcribed interviews revealed various ideas and beliefs related to culture, ethnicity, and learning. Hence, such participant ideas were then reconstructed and categorized resulting in subsequent interrelationships between the three constructs to be established. These

relationships served as means for an overall reconstruction of the participants views of reality regarding culture, ethnicity, and learning.

Results and Interpretations

Results of the data are presented in the form of interviewer/participant dialogues. In the dialogues, the three preservice science teachers discuss their ideas about culture and ethnicity, describe critical incidents or cultural bumps and reflect on science learning. Interpretations of the interviews are based on line by line analysis of participant responses, as well as the interpreter's understanding of the topics being discussed. The interpretations of individual participant's responses provide a qualitative basis so that reasonable inferences could be made about these preservice science teachers' ideas about the constructs of culture, ethnicity, and science learning of marginalized students.

Participants' Ideas About Culture and Ethnicity

The participants' ideas about culture range from associating the term with aspects of "high society" aesthetics (Ray) and individual personality (Tammy) to people's behavior, beliefs, and values (Sonia). Collectively, all three of the participants appear to have the most difficulty with the construct ethnicity. In many instances, the participants equate the terms culture and ethnicity and easily became confused. Notice the following conversation with Ray:

> I guess the first thing you think about the word culture. . . people say, "well, he's cultured; he likes to go to the art museums and listen to opera.."
>
> Interviewer: Like the fine arts?

Ray: Yea, that would be culture and also you think of culture as different countries have your own culture [sic].

Interviewer: Okay, what do you think the word ethnicity means? What does it mean to you?

Ray: Ethnicity? Wherever a person is from is the culture that he follows, their values, their..that's a hard one, I guess.

In an attempt to gain further insight on Ray's ideas about ethnicity, he was asked what the word minority meant to him. He had this to say:

Ray: Minority? Someone out of the majority.

Interviewer: Okay... is it different from the word ethnicity?

Ray: I don't think so. There are different categories of minorities who have handicaps of all ethnic groups.

Interviewer: Like physical handicaps?

Ray: Physical handicaps....

During an informal conversation, Ray acknowledges the existence of culture and ethnicity among students. However, the extent of his understanding is limited to interactional differences between cultural groups and tangible objects such as food and clothing. Ray's perception is that only people of color or perhaps people who appear "exotic" in comparison to other White Americans, are inherently possessors of a culture and an ethnicity. Ray, like many White Americans, feel that he is devoid of a culture, as well as an ethnicity. He describes himself as American.

Ray: I am American. I don't feel myself as a Southerner. That would be another type of culture.

It is important to Ray not to be labelled as a Southerner. It seems that he has internalized a negative perception of people from the South, but he does not disclose to the interviewer his reasons for such a perception.

Of the three participants, Sonia appears to have the most conceptualized understanding of culture and ethnicity. She believes that culture has more than one attribute. However, ethnicity is more definitive of one's race and ancestral heritage. This is what she says:

Culture is kind of complex. Culture is not only the behavior, how people look or act. It is a combination of everything. Beliefs and values. There are somethings [sic] I read as very Colombian. But I think they are universal. To me, well, I cannot define culture as one thing. I don't see my family fit into the culture here very well. It is kind of strange but sometimes I don't consider myself as minority.

Interviewer: What do you think ethnicity is?

Sonia: To me it is the race, your ancestors, where you are coming from,... kind of lineage. To me all people of the same group I consider as "artesians". To me this is close to culture.

Interviewer: What do you think the word "minority" means?

Sonia: For me "minority" is a group of people that don't [sic] fit into culture, I mean whichever country you are in.

The fact that Sonia identifies herself specifically as a Hispanic as opposed to a Latino was an interesting revelation. Sonia states 'I still have my own identity. I don't have any

problem with the culture I am in.' These statements appear to imply that Sonia is quite aware (and perhaps has come to accommodate) that the Latin culture is viewed negatively by others in the United States. Based on her interviews and prior knowledge of her as a student at the university, one can believe that Sonia finds it more advantageous in some respects to self-identify as Hispanic as opposed to Latino in various settings, such as the university.

Tammy seems to believe that primarily culture describes individual personalities, beliefs, and values whereas ethnicity refers to more specific individual characteristics.

Tammy: What do I think culture is? Humm. Let's see. I think culture describes, umm, who someone is; umm, it describes the environment in which they grew up, it also describes, umm, the way in which they were raised. Umm, I don't think anyone has the same culture. I think they may have grown up in the same area and they may have had some of the same experiences but I think it's just the general makeup of the world around them and umm, different things that kind of describes who they are.

Interviewer: Kind of like an individual thing.

Tammy: Yes.

Interviewer: What do you think ethnicity is?

Tammy: Ummm, ethnicity. I think that and culture are very close. I don't really see that much of a division between the two. Umm, I know just if somebody had just said it first to me, I would think well, that is again where somebody grew up and their experiences, and their past and it really makes up who

> they, you know, who they are. There's more to a person than just their culture and their ethnicity but just looking at the surface, it is, you know, the makeup of who someone is and their experiences.

Tammy recognizes that there is a difference between culture and ethnicity, but is unsure as to where the dichotomy lies between the two. Tammy believes that culture is definitive of one's environment, but primarily it is an individual's personality or overall persona rather than the beliefs, attitudes, values, etc. that influence one's personality. Similarly, she believes ethnicity is merely a descriptive term used in society, but in general it too describes an individual's personality. For Tammy, no one "has the same culture" because no two people or personalities are alike. Identifying with a particular culture is not important---only identifying and knowing self is of importance.

Tammy probably has experienced several cultural bumps which has allowed her to begin to reflect and initiate positive changes in her interactions, attitude, and treatment of others. Notice the following:

> I got into a calculus class and I had a professor that was Oriental [sic]. Umm, and I'd raise my hand, I'd ask a question and he'd ignore me. Or he would just kind of shun me off with a real quick answer. He wouldn't, he wouldn't pay me any mind. I had questions. It really wasn't important to him whereas if somebody else in the class raised their hand and they were also Oriental [sic], he gave their questions major consideration. [He] went into great detail to explain it and for the first time in my life I felt discriminated against and it was a painful experience...

Tammy's cultural bump with her Asian calculus professor allows her to experience feelings of discrimination, "voicelessness", and alienation that marginalized persons often experience.

Participants' Ideas About Learning in Relation to Marginalized Students

Except in the case of Sonia, the social aspect of learning (social cognition), is not an element of their conception of learning. In other words, such constructs as culture and ethnicity have little impact on their view of science learning. They believe that such things as student characteristics influence interactional or behavioral patterns, styles of dress, and overall appearance, but not particularly the ways students from marginalized groups learned science. In an earlier interview with Ray, he mentions his own apprehensiveness and discomfort when working with others whom he does not normally associate. Nevertheless, he talks about cooperative learning. Because of his lack of cultural bumps with others from cultures and ethnicities (as well as class backgrounds) different from his own, he internalizeds many stereotypes about members of these groups. Notice the following conversation:

Interviewer: How do you think your student's from backgrounds different from your own come to know science ideas. Again, think of a class of 25 students. How do they come to know science ideas if they have backgrounds different from you? Or do you?

Ray: I'm sure they are going to have different ideas, depending on [their] social or economic status because if their parents didn't go to college or finish high school, they are not really going to be interested in science that much and they

are not going to stress that to their children. And maybe the only way they are going to learn science is maybe on TV and if they don't have enough money to watch TV, then they are not going to get it from that. So maybe their idea of science is going outside and playing with their friends in the dirt and seeing worms and insects and stuff. That might be the only concept you have and then on the other end of the spectrum, professor parents may be more knowledgeable than you may be.

It appears that students' culture will have very little place in Ray's future science classroom. Ray makes a stereotypical assumption that lower economic and social class parents emphasize science learning less than their counterparts. The irony of Ray's comment is that he is from a middle class family, but at no time during any of his interviews did he mention his parents as being a influence on his interest in science. In addition, Ray trivializes and demeans students' science learning that is inspired by curiosity of nature or that which is learned from TV. However, in terms of his own science learning, he stresses the positiveness of such experiences.

Ray: I learn a lot from TV, especially the Discovery Channel. For example, I watched it last night and the show was on the origin of the universe. It showed me that theories change.

It is likely that Ray will target higher socio-economic children for his science teaching since they would most likely be a reflection of his "good" science teaching. Lower achievers will probably be seen as merely a product of their environment, of which he feels he has little to no control.

Tammy, on the other hand, questions inequities in educational policies and practices, but she denies the existence of her own cultural and ethnic identity.

> ...I don't really say that I am any particular culture; that's not the first thing I notice about somebody. Umm, let's see. If anything I just describe how I am, I describe my personality, how I communicate. I guess that's what I consider.. my culture to be. I don't group it aside from any other thing.

Tammy essentially denied her cultural/ethnic identification. Such self denial makes it difficult, if not impossible, to understand and embrace the identities of others.

Both Tammy and Ray seemed to believe that learning is a sequential process of gathering facts and other information via observation, reading, etc. Tammy comments:

> ... just by observation and watching the butterflies and then touching, what are they actually doing?-- and getting real close, I learned. That was one of my first experiences in science. Unfortunately, when you get to college you can't always observe everything that you're having to learn in science. Therefore, you have to do a lot of reading in books and you spend a lot of time just trying to comprehend what they're talking about. I learn a lot on the computers because they have it now where you can sit down and you can do so much. It's all right there and also I learned a lot from reading. Learning science for me was reading articles--reading exciting things in books.

To them, the result of learning always leads one to assemble a view of particular phenomena in science based on various information, ideas, or parts. Tammy's and Ray's ways of knowing are indicative of the way in which they intend to instruct their students. The dichotomy is that their preferred way of learning and instruction is less effective with

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many marginalized students. Tammy and Ray do not have a conceptual understanding of the nature and complexity of culture and ethnicity, therefore they will be unable to link these constructs to marginalized students' learning. They will continue to instruct these students in their own preferred mode of learning.

Sonia acknowledges that learning is perhaps a process, but her idea is that achieving an understanding is the ultimate goal of the learning process. In other words, Sonia's ideas about learning patterns those of Ausubel's (1968) meaningful learning. Hence memorization is not seen as a tool for meaningful learning, but rather a short-lived school survival tactic.

Interviewer: How do you think you learn science in general? Reflect on your various learning experiences in science. How do you learn science in different contexts?

Sonia: By my experiences. You know I went to school to become a biologist. In all those years I had different kinds of experiences and acquired knowledge. I went to graduate school and stayed in the same field and also I did research and also that is a good way to learn science for me. I think my life [is] basically going to school, doing research, talking with people in the same area. I learn science well. First of all, I have to write down something. It will be easier for me to have some kind of visual presentation--to have something to visualize what the person is trying to say. Also if I can do some kind of experiment or work with something that will lead me to explore what the person has presented, this will make me learn more than just sitting

there and listening. I don't think I will get so much out. Maybe I will remember for a couple of hours or so and then I forget. But if I have actually done or seen something, I will [be] more likely to remember. I think for me, one of the best ways to learn science is when I am actually doing it; when I was working in the lab, and when I was writing papers. He (her supervisor) showed me how to organize my knowledge, my data, and how to show people I have learned.

Interviewer: How do you think you come to know science ideas?

Sonia: I don't remember details. I need the same thing in all sciences. I probably like biology because we did more lab work. I learned more because of that. I remember more too. I think, for any science you have to present in different ways. Science should be presented in different ways independent of the context.

Interviewer: How do you know when you know something? What is your source of confidence?

Sonia: When I know something I can be very confident. Then I really know what I am doing. I want to teach biology or life science. I do have strong background in that area. So, even if I don't remember little details, I can always go back and can review. Once I plan a lesson, I do feel very confident because you know I do have something with me. It is something I am learning and at the same time I am learning to teach. Sometimes, I do have to learn at the same time and I will learn from the students. Usually if I

> am teaching in my content area I can feel confident. It is easier for me to present it, for me to question the students. It will be very different for me if I were to teach chemistry....I don't remember anything probably, even though I took chemistry. It will be lot more difficult than biology.

Sonia is asked how she would instruct her students and how she believes students from different backgrounds come to know science ideas. This is what she had to say:

> Different ways. If I have people from different cultures, they are going to have [the] same ideas presented in different ways. For example, a banana. I have one from Georgia, an American, an African American student. If I ask what color is the banana? Maybe everyone will think the correct answer is yellow. But my Latin American students may say green because it could relate to plantain because most of the times plantain is green in Latin America. The African American could relate that to brown because they may like it more ripe. You know very simple concepts can be understood different ways because of the culture they are coming from. So, you have to be very open minded. You cannot have a right answer for anything. You have to get feedback from the students. It would be a very good situation to have a multicultural group in your classroom...they learn the way yellow color is the right way [sic].

Sonia wholeheartedly believes that students' cultures and ethnicities can affect the way in which they perceive science material. Because of this awareness, Sonia is very much aware of student differences and it is likely that she will use a variety of teaching strategies to accommodate the learning needs of marginalized students. However in terms of Sonia's

future actions and commitment to students belonging to marginalized groups, the issue becomes complex for her.

To reinforce what is learned in a lecture, Sonia believes that hands-on activities would be the best method and the context of meaning derived from any learning depends on the students and their culture. The fact that Sonia is a person of color perhaps has influenced her awareness of the learning style preferences and cultural influences on the science learning of marginalized students. She believes that meaning is contextual, therefore interpretations vary among students. Sonia firmly believes that the science learning she has acquired in different environments will provide the knowledge base for teaching a multicultural group of students. Sonia conceives that teaching a pluralistic group of students requires effort on the part of the teacher. She is confident that her self-awareness as a Hispanic female will have a positive influence on her students because she can relate and understand the issues and problems associated with cultural groups. However, it was interesting that Sonia believes that African Americans prefer bananas overripe as opposed to yellow. Even though Sonia is trying to point out how students' cultures affect their perceptions and preferences, she nevertheless does so at the expense of drawing a stereotypical conclusion about African Americans in her example. In addition, she stresses there is no right or wrong answer but she does imply that yellow was the correct answer for American students give. Sonia will probably do well teaching motivated Hispanic or Latino students because such students will probably pose little conflict with her self concerns as a beginning teacher and international person. However, in the case of African American, Native Americans, Asian students, and less motivated Hispanic and Latino students,

Sonia's commitment to these students' learning is questionable based on some of the stereotypical assumptions disclosed in her interviews and her own need for assimilation into White American culture. Like Tammy and Ray, Sonia focuses on her own survival as not only a beginning science teacher, but as an international science teacher. It is likely that she will take risks for her future marginalized student, but only after these self-concerns and others are dissolved. Only after Sonia dissolves her self-concerns will it be likely that she will take risks for all marginalized students.

In summary, Tammy is presently unwilling to forget about her self concerns, therefore she is unlikely to meet the learning needs of marginalized students. For Ray, he sees no need to take into account the culture and ethnicity of students in his science classroom. Doing so would jeopardize his appearance and others perception of him as a good beginning teacher. It appears that Ray will not take risks to meet the needs of marginalized students, nor is it likely that he will embrace multiculturalism in his science classroom. Sonia has many self concerns as a beginning teacher. Her primary concerns are centered around her self-identification with a marginalized group. However, this self-identification conflicts with her desire to be accepted into the mainstream culture. Hence, her beliefs about the influence of culture and ethnicity on the learning of marginalized students will be of little use in her science classroom. As previously stated, Sonia will probably do well teaching 'mainstream' marginalized students. She sees culture and ethnicity impacting students intellectual learning, but she will not attribute these constructs to her beliefs about unacceptable or 'inappropriate' student actions in her classroom.

Discussion and Implications

The diversification of our nation's science classrooms makes it very important to commit to equitable instructional practices and to accommodate all science learners. The findings in this study reveal that for the most part, the participants are ill-prepared to meet the challenges of cultural and ethnic diversity in their science classrooms. Hence their ideas about culture and ethnicity have little impact on their perception of how students learn science. The three participants possess specific ideas about culture; however, the construct ethnicity was more perplexing to them. They equate the terms culture and ethnicity and some believe they were analogous constructs. They become easily confused about the two constructs during the interview. Ray acknowledges the existence of culture and ethnicity among students; however, the extent of his knowledge is limited to interactional differences between cultural groups and tangible objects such as food and clothing. Tammy believes that culture describes individual personalities, beliefs, and values, whereas ethnicity refers to more specific individual characteristics. Sonia exhibits the most conceptualized ideas about culture; however, her ideas about ethnicity are comparable to those of culture. Both Ray and Tammy do not appear to believe that cultures and ethnicities influenced students' science learning, whereas Sonia can explicate the ways culture might influence science learning.

Ray acknowledges the existence of culture and ethnicity among students; however, the extent of his understanding is limited to interactional differences between cultural groups and tangible objects such as food and clothing. He does not describe any cultural bumps; therefore, he has few if any cultural interactions to assist him in clarifying his ideas about

people from cultures and ethnicities different from his own. Ray, like many White Americans, feels that he is devoid of ethnicity. He describes himself as American. His perception is that only people of color or perhaps people who appear "exotic" in comparison to other White Americans and are inherently possessors of culture and ethnicity. Ray's unawareness of his own culture continues to insulate him from many of the cultural aspects of teaching and learning.

Tammy does not explicitly mention or discuss the plight of marginalized students; but, the interviewer does not feel that Tammy is unaware of such an issue. Rather, the interpretation is that Tammy wishes to avoid such issues if all possible. She believes that solely her job is to instruct her students to the best of her ability and to be open to the students. Tammy desires to be an ideal science teacher; "ideal science teacher" meaning one who instructs her students with various teaching strategies (but primarily hands-on activities), interacts with the students, and has a friendly and open relationship with her students. The problem is that most schools are not ideal schools and neither are some of its students seen as ideal.

Sonia has the most conceptualized ideas about culture. Her travels and experiences with numerous cultures (as well as her experiences as a result of her membership in a marinalized group) have caused her to encounter many cultural bumps. For Sonia, culture encompasses one's beliefs, values, and world views, as well as the tangible aspects of a given society such as food and dress. However, her idea about the construct of ethnicity is similar to culture. Nevertheless, Sonia's understanding of culture allows her to accommodate and in some cases to assimilate into American White culture. Sonia says

during her interview that she does not have any problem with the culture from which she comes. Undoubtedly, Sonia has had many cultural bumps and such encounters appear to have caused her to spiral among stages 3 and 4 of ethnic identity development. Clarification and reflection of these encounters and her understanding the implications of being a person of color will assist in establishing a comfortable acceptance of her own identity, equitable science instruction, and her treatment of her future students.

Addressing the constructs of culture and ethnicity in the field of science are often seen as irrelevant and unimportant, even amongst the experts. Hence it is not surprising that novices such as preservice science teachers dismiss and devalue these factors and subcome to these same beliefs so that they are unable to modify their teaching actions and practices to accommodate the learning, behaviors, motivation, attitudes, and communication that their students bring to the classroom. Some preservice teachers will be unable to transform science classrooms into safe environments for students to further develop their own self identity, actualization, and learning of science (McDaniel, Devi, Crockett, & Atwater, 1995).

Cultural and ethnic development of preservice science teachers and their opportunities to experience equitable science instruction are necessities if all students are to learn quality science. The primary theme that emerged as a result of this study is the need for preservice science teachers to experience many cultural encounters or cultural bumps before and during student teaching. It is here that multicultural science teacher educators can assist preservice teachers in understanding the occurrence.

Implications for Science Teacher Education Programs

Providing cultural bumps for preservice science teachers is not an unreasonable nor overly ambitious task. Field experiences (such as student teaching, practicums, tutoring, and volunteering to work in various civic and youth organizations) and multicultural course requirements are two avenues that can be taken in providing preservice science teachers with cultural bumps. Field experiences have been shown to be valuable and effective, if properly implemented and monitored, in providing experiences for preservice teachers with students form cultures and ethnicities different from their own. Courses in multicultural education or related areas can serve as strong foundations for the development of effective multicultural science educators. Discussions and understandings of such topics as ethnic and racial identity development theories provide a framework for resepct, valuing, and understanding for all students as individuals and their learning of science. With such understandings, preservice teachers can begin to realize for themselves the necessity of modifying teaching actions, practices, and challenging inequitable policies such that the various learning and communicational style preferences, motivations, and attitudes of students are not only accommodated, but appreciated.

Without a doubt, one-on-one interaction with students from various cultures and ethnicities will usually initiate the occurrence of a cultural bump. The preservice teachers' encounters allow them to evaluate and react to the situation from a multicultural perspective as opposed to one that is based on mainstream white standards and expectations. Much time and consideration must be given to the selection of the site for the field experiences. One should not always expect positive outcomes simply because prospective teachers are

placed in a classroom that is composed primarily of marginalized students (Bollin & Finkel, 1995). Teacher educators and coordinators of the field experiences need to account for such factors as the preservice and cooperating teachers' cultural and ethnic development (their awareness and acceptance of cultures and ethnicities different from their own). If a prospective teacher is placed in a situation where he or she is uncomfortable, unwilling, unmotivated or uncommitted to accommodating diversity, then the effects can be damaging to the students in terms of their learning and self identity (Ladson-Billings, 1995), as well as the teacher's own development as a teacher and as an individual (Lipman, 1995).

Implications for Further Research

Further research is warranted by the findings in this qualitative study as to the importance of cultural bumps and the necessity of teacher education programs to provide prospective science teachers with cultural and ethnic encounters. In terms of this particular study, a two to three year follow-up study on the three participants will provide insightful information about teacher development. The apparent need and importance for preservice science teachers to experience cultural bumps make several important questions become salient to address. Such questions are:

(1) How can science teacher educators provide opportunities for meaningful cultural bumps to assist preservice science teachers to become bicultural and multicultural science teachers?

(2) What are the resources necessary to provide preservice teachers opportunities for meaningful cultural bumps?

As a profession founded on the principles of democracy and eqitable opportunity, science teacher educators have a responsibility to instruct prospective teachers so that they will be able to create and maintain equitable classrooms that are conducive for every student to learn quality science (Atwater, 1994; 1995a; 1995b). By providing these teachers with a preservice preparation program that values, embraces, and understands diversity, teacher educators enhance the likelihood that such as goal will be achieved.

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Table 1

Examples of Interview Questions

1. What do you think the word ethnicity means?
2. How do you think your cultural/ethnic identification affected your high school science learning experience?
3. How do you think your students from backgrounds different from your own come to know science?
4. How would you determine a student's culture? How would you determine a student's ethnicity?
5. What do you think equity/fairness means in the science classes that you are teaching?